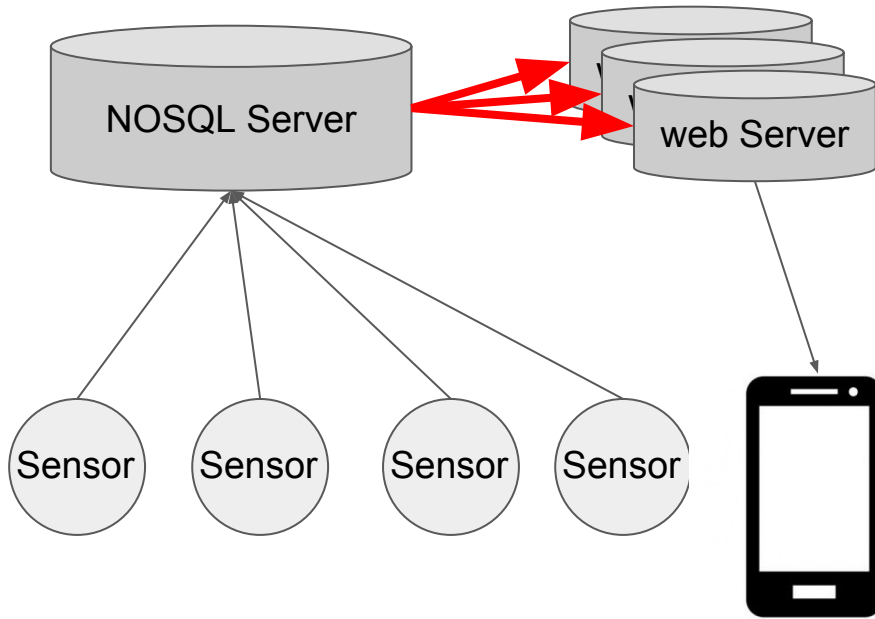


# NOSQL Hardware appliance with Multiple Data Structure

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# An Embedded NOSQL System



- ❖ IoT and Sensor technology make data explosive which cannot handle enough
  - Data store like NOSQL is required more throughput and low power.
  - Hardware based Solution is one of hot topics.
- ❖ Related works in Hardware design
  - Standalone FPGA [Blott]
  - CPU + FPGA [Chalamalasetti], [Lim]

[Chalamalasetti] S. R. Chalamalasetti, et al, "An FPGA Memcached Appliance," in Proceedings of the International Symposium on FPGA'13, Feb. 2013.

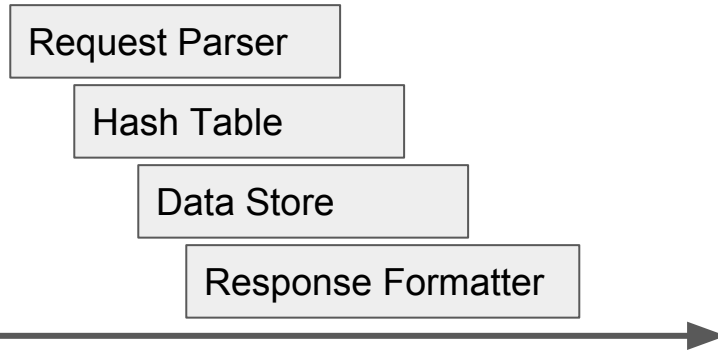
[Blott] M. Blott and K. Vissers, "Dataflow Architectures for 10Gbps Line-rate Key-value-Stores," in Proceedings of HotChips'13, Aug. 2013.

[Lim] K. Lim, et al "Thin Servers with Smart Pipes: Designing SoC Accelerators for Memcached," in Proceedings of the ISCA'13, Jun. 2013.

# Design Problems

## A simple data structure

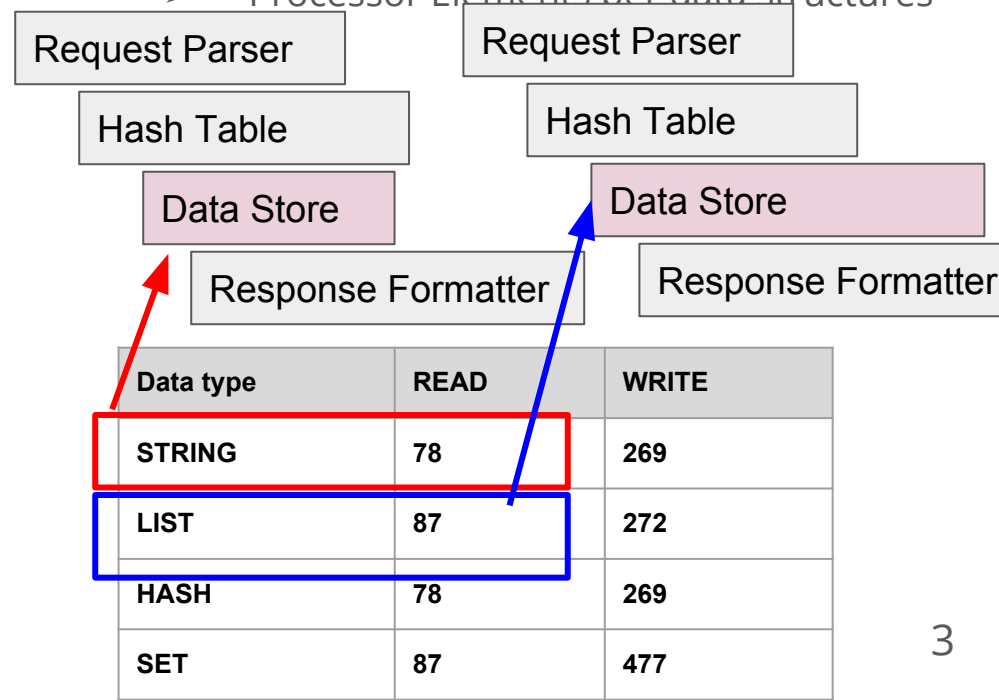
- ❖ Deep Pipelining
  - A simple data structure (e.g., String)
  - Data store processing has constant execution clock cycles.



Deep pipelining,  
Simple Implementation.

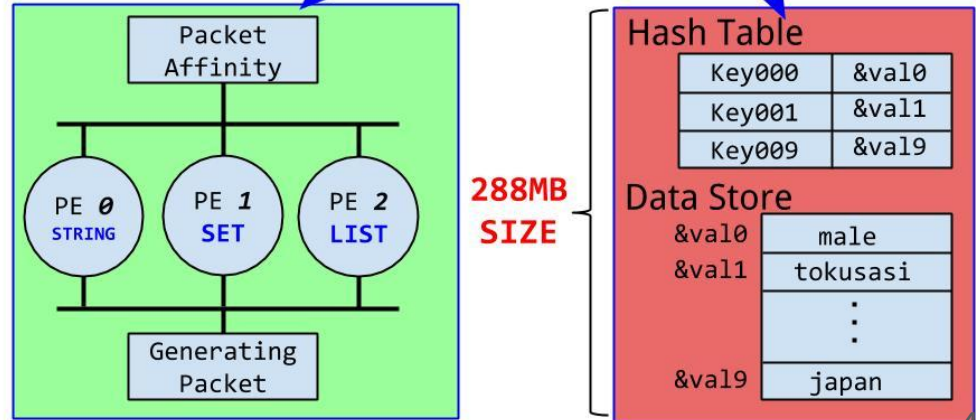
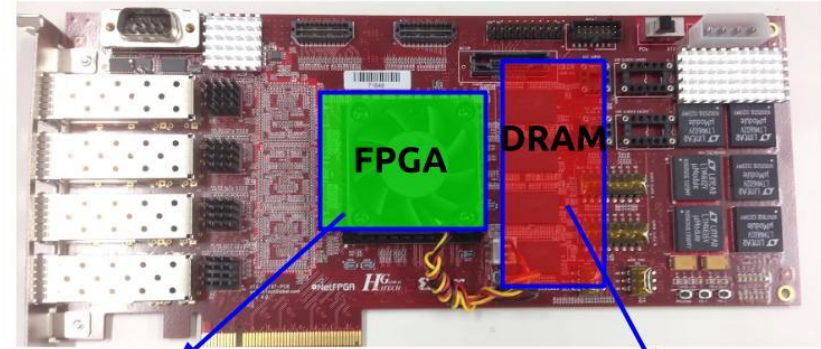
## Various data structures

- ❖ Heterogeneous Multi-PE
  - Deeply Pipelining is cost-full in implementation
  - Processor Elements per data structures



# Design and Implement

- ❖ Heterogeneous Multi-PE design
  - PEs per data structures
  - STRING, LIST, SET, HASH is available
- ❖ Targeting Board: NetFPGA-10G
  - Virtex-5 XC4VTX240T
  - RLDRAM-II 288MB
  - NetFPGA SUME (8GB DRAM) is also available as Next generation board
- ❖ PE Performance
  - 1 PE has 1.4Mops
  - Achievement 10GbE line rate with integrating multiple PEs
  - Requires 7~9 PEs for 10GbE line rate



# Evaluations

## ❖ Energy Efficiency

- Compared with related work
- 2.4--12.4x improvement

## ❖ Area (Virtex-5 XC5VTX240T)

- Up to 11 PEs are implemented

## ❖ PEs throughput on 10GbE

- Calculation based 1PE throughput
- 7 PEs is required in write requests
- 9 PEs is required in read requests

